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ABSTRACT

Personal observations suggest that conventional evaluation methods used in methods courses heighten rather than alleviate the insecurity of teachers who suffer from science anxiety. The primary purpose of this study was to explore the benefits of a graduate science methods course that used a nonthreatening evaluation method. This method consisted of "contrived observations," or lists of new experiences or "firsts" occurring during the course. The "firsts" were further documented by the "anecdotal diary" that all the teachers kept while taking the course. The enthusiasm of the methods course participants in this study suggests that a nonthreatening evaluation system can be effective in reducing anxiety associated with teaching science. (CJ)

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Documenting the Attitudinal, Cognitive, and Behavioral Effects of a Graduate Science Methods Course Using Unobtrusive Measures: A Descriptive Study.

J. Ronald Gardella

The reluctance of elementary teachers to teach science has been noted in the history of the elementary curriculum and is a primary deterrent to the teaching of any science program (Piper and Moore, 1977). A variety of reasons for this is noted in the literature. Negative teacher attitudes toward science is the primary factor contributing to this reluctance (Piper and Moore, 1977). Insecurity with, and the lack of science content, lack of knowledge about science methodology, and negative personal experiences with science and among others noted (Butzow, 1973; Piltz, 1954; Ritz, 1969; Soy, 1967 and Victor, 1962). Collectively these conditions may be termed science anxiety.

Undergraduate, graduate, and in-service science methods courses are viewed as valid ways of remediating these problems particulary if they are sensitive to science education research and local needs (Bethel, Piper, and Lamb, 1977). However good a methods course may be, personal observations suggest that conventional evaluation methods such as objective tests and essays, etc. often heighten the insecurity of a science anxious population and complicate the task of remediating the science anxiety. In turn, the extent to which science will be taught might be affected.

Purpose

The primary purpose of this study was to explore evaluating the attitudinal, cognitive, and behavioral effects of a graduate

science methods course using a non-threatening evaluation method. The method was a combination of "contrived observation" and the "anecdotal diary". Both methods are described as categories of Unobtrusive Measures. (Webb, Campbell, et al, 1966; Weick, 1954). The contrived observations were lists of new experiences or "firsts" compiled by participants on a weekly basis and documented as valid by an anecdotal diary maintained by each participant.

The Course

The course in this study was a science methods course, "Teaching Life Science in the Elementary School", a modification of a televised course of the same name developed by Western Kentucky University. The course was a series of fourteen televised sequences of teachers teaching selected life science concepts in Kentucky schools. The life science content and methods were adapted from the Science Curriculum Improvement Study program. A programmed guide and selected readings accompanied the televised lessons.

The course included fifteen weekly, on-campus meetings devoted to viewing and discussing the televised lessons, clarifying the program guide and activities, discussing the related readings, doing other life science activities not included in the guide, and having participants share their experiences with lesson activities with each other. As the course progressed more time was spent on the "hands-on" activities.

In the course students were expected to view each lesson complete the program guide activities, read assigned articles,

compile a weekly list of new experiences or firsts related to the course, keep an activity diary of activities, feelings, and attitudes about the course, involve their students with the materials and methods introduced in the course when possible, and complete a final descriptive course evaluation at the end of the course.

Research Questions

The following questions were set for the study. They were not communicated to the participants.

As a result of taking the course "Teaching Life Science In The Elementary School, will participants:

1. Teach science to their classes using any method?
2. Use a direct experience approach when teaching science?
3. Express a positive attitude toward teaching science.
4. Demonstrate increased knowledge of life science teaching methods.
5. Demonstrate increased knowledge of life science content.
6. Acquire and maintain living materials that support teaching life science.

Participants

The participants in this study were 16 practicing elementary school teachers from Norhtern Kentucky enrolled in the graduate course EDU 698 KET Study: Teaching Life Science in the Elementary School at Northern Kentucky University. Of the 16 participants, two were teaching in grades K, 1, 2, 3, 4, and 6 respectfully. One participant was teaching 5th grade. One was an elementary school permanent substitute and one was a homebound instructor.

The participants were predominantly science anxious people. Most felt inadequately prepared in science content, some related poor personal experiences with science, one was discouraged from teaching science by her school administration, and most lacked equipment and materials to teach science. Generally the population reflected the characteristics of elementary teachers that discourage them from teaching reported by Weiss (1977). As a group they were interested in improving their skills in teaching science and approached the methods course with some trepidation.

Evaluation Procedures

This study was a post-test only, quasi-experimental design (Campbell & Stanley, 1969). The principle evaluation methods used to test the effects of the course was a list of new experiences or "firsts" compiled on a weekly basis by each participant. The "first" listed by each participant documents a new experience, attitude, behavior, or knowledge. By definition it never occured before and indicates a change taking place and the nature of the change e.g. "This is the first time I taught science." etc.

Recalled information such as lists of firsts is termed "reconstructed data". Weber et al (1965) discuss the validity problems associated with this and recommend additional measures to validate the data. The additional measure in this study was an anecdotal diary of feeling, experiences, and comments associated with the course, maintained by each participant. Each participant's diary was reviewed weekly and compared to their lists of firsts to establish if the listed firsts were reasonable

expressions of the individual's feelings, experiences etc. Any first not documented by this method was not retained for the study.

The firsts were used only once and classified according to one of the research questions asked in the study. A frequency distribution of firsts for each question was developed and is reported in Table I.

Additional evaluation measures included the Program Guide and Final Descriptive Course Evaluation. The Final Descriptive Course Evaluation was an instrument that asked participants to comment on various aspects of the course such as course format, evaluation methods, activities etc. Further, it specifically asked, "How comfortable do you feel with teaching science as a result of taking this course?" The instrument was designed to give the instructor some suggestions for improving the course and to check on the validity of the evaluation method for Question #3, expressing a positive attitude about teaching science.

The program guide was a worktext that required students to provide written responses to the activities associated with each lesson. This was checked for completeness.

Results

Sixteen participants listed a total of 512 discrete firsts as a result of taking the course with an average of 32 new experiences of firsts for each participant. Interpretations of the data are presented under each question.

Questions 1 and 2

The data for questions 1 and 2 were compressed and collectively interpreted as both questions relate to the act of teaching science.

Firsts that either directly stated "I teach science" or described a science teaching situation other than using direct experience were counted for Question 1.

Firsts that referred to the direct involvement of students with materials used in science instruction were counted for Question 2 and not for Question 1. e.g. "I taught science through hands on experiments" etc.

One hundred fifty-three (153) firsts or 30% of the total items listed related directly to Questions 1 and 2. Fourteen participants listed items for both questions and the 2 remaining participants listed items for either one or the other. All participants did therefore teach science.

Fifty-three (53) items or 10% of all items listed related to general methods of teaching science while 100 items or 20% referred to direct experience teaching. Therefore 70% of all science teaching that occurred did reflect a direct experience approach. Participants did teach science and used a direct experience approach as the predominant method.

Question 3

This question is interpreted to include any new experience that describes or indicates positive feelings or attitudes about teaching science e.g. "This is the first time I wanted to teach science" etc.

Thirty-one (31) discrete items or 6% of the total items listed related to this question. Eleven participants reported

Individual Participants	Question #1 Teaching science any method	Question #2 Teaching science Direct experience approach	Question #3 Express positive attitude toward teaching science	Question #4 Increased knowledge of science methods	Question #5 Increased knowledge/life science content	Question #6 Acquire/maintain living materials	Total number of "firsts" for each participant
I	3	4	1	6	3	1	18
II	6	16	0	7	1	5	35
III	6	10	7	31	18	4	76
IV	2	1	11	20	12	6	52
V	2	4	0	5	6	3	20
VI	0	6	3	13	6	5	33
VII	6	12	1	4	3	1	27
VIII	1	0	2	4	3	4	14
IX	4	8	1	1	1	6	21
X	1	1	0	9	4	1	16
XI	3	4	1	20	13	3	44
XII	3	3	1	12	14	3	36
XIII	1	8	1	5	2	2	20
XIV	3	7	0	10	4	1	25
XV	4	3	0	4	1	1	13
XVI	8	13	2	15	15	9	62
Total No. "Firsts"	53	100	31	166	106	56	512
	153						
% of Total No.	10%	20%	6%	32%	21%	11%	100%
	30%						
Mean $\bar{X}$	3	6	2	10	7	4	32
	10						

Table I Number of "Firsts Listed by Participants After Treatment"

an average of 3 firsts. This low number would suggest that the course did not affect participants attitudes toward teaching. However, the 5 remaining participants that did not list positive attitudes as new did teach science. Additionally, these same 5 participants did indicate a positive attitude toward teaching on the attitude question on the Final Descriptive Course Evaluation. It is logical to assume then that they already had a positive attitude toward teaching science and reflected it in teaching science. These results suggest that the participants did reflect a positive attitude toward teaching science as a result of the course if a positive attitude about teaching science was not already held.

Question 4

This question relates to professional content or information that describes facts, concepts, and/or techniques about teaching science. Firsts that related to any of these interpretations were counted as positive responses.

One hundred sixty-six (166) firsts or 32% of the total items listed were related to this question. Further, each participant listed an average of 10 firsts. It would appear that this was an area in which the participants had little knowledge or experience and that the course was particularly effective in communicating new mehtods of teaching science to the participants.

Question 5

This question relates to facts or concepts about living things, or biological science. Firsts that related specifically to these interpretations were counted as positive responses.

One hundred six (106) discrete firsts or 21% of the total items listed related to this question with an average of 7 items per participant. Given the ease with listing new facts as a first, one would expect a higher number of firsts. One might infer that the participants were not severly lacking in life science content and the firsts indicate the knowledge gained over that already held. The response to this question is sufficient to state that the course was effective in communicating some life science content. Given the methods emphasis of the course this is not surprising.

Question 6

Firsts that related to the acquisition and or maintenance of animals, plants, terraria and aquaria were accepted as positive responses to this question.

Fifty-six (56) firsts or 11% of the total items listed were related to this question. This response represents an average of 4 items per participant. This question requires a behavioral response involving multiple tasks that were new to most of the participants. As a result, a limited response would not be unrealistic. It could best be said that as a result of the data, the course did encourage some participants to acquire and/or maintain living materials.

The results indicate that the research questions posed were answered positively and that the course was effective in encouraging elementary school teachers to teach science.

Discussion

This study is limited and exploratory. It would be presumptious to do more than note some observations and inferences about its use.

The Firsts Approach is a simple technique to use, yet, it is an effective indicator of change in some respects. If something is listed as a first and validated as true, it must be assumed that it never occurred before, is a valid indicator of change and describes what the change is. Additionally, it shows that the treatment did cause the described change e.g. "This is the first time I like teaching science". It would appear reasonable that the greater number of firsts in a particular category would indicate the degree of change. This appears true as long as one limits the interpretation of degree to a single category such as attitudes, knowledge, or behavior and does not generalize across all three categories.

Attitudes, knowledge, and behavior are different dimensions. These differences are reflected in such things as how they are changed and reported. It is inferred that the more complex the category such as attitudes or behavior, the fewer and more comprehensive the reported firsts. One statement such as "I now like to teach science" is sufficient evidence to meet a goal regarding positive attitudes toward teaching science. Behavioral changes that involve multiple tasks and new knowledge are most complex dimensions. They too result in fewer, more comprehensive firsts. Firsts in the knowledge category are much

less comprehensive as are the individual facts they document.

The validity of the Firsts Approach appears to rest on an additional measure such as the anecdotal diary. The anecdotal diary was effective in documenting the validity of the stated firsts. It was time consuming but an excellent formative evaluation instrument on its own. Participants were more willing to share their feelings, opinions, and experiences in the diary than on a "face-to-face" basis with the instructor. Additionally, the instructor was able to detect any severe problems the students were having and adjust the course or respond as necessary. Additionally the anecdotal diary served as an excellent reinforcement device. One student noted, "It was a good way to look back on what I had done."

The Firsts Approach has been used with the same course when it was taught again and with undergraduate teacher education students in conjunction with field-based methods courses in Reading, Language Arts, Social Studies, Mathematics, and Science. The observations and inferences reported in this study appear to hold true.

Elementary teachers continue to deal with many factors that support science anxiety and discourage them from teaching science. The enthusiasm of the participants in this study suggests that a non-threatening evaluation system can be effective in reducing anxiety associated with teaching science and encourage elementary teachers to teach science.

The First Approach is an interesting evaluation method. It was satisfactory and supportive to the course described in this study. Its value and application beyond that described in this study have yet to be determined by further research.

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